As We May Work:

Free minds from Routines and Enable Creativity and Intuition
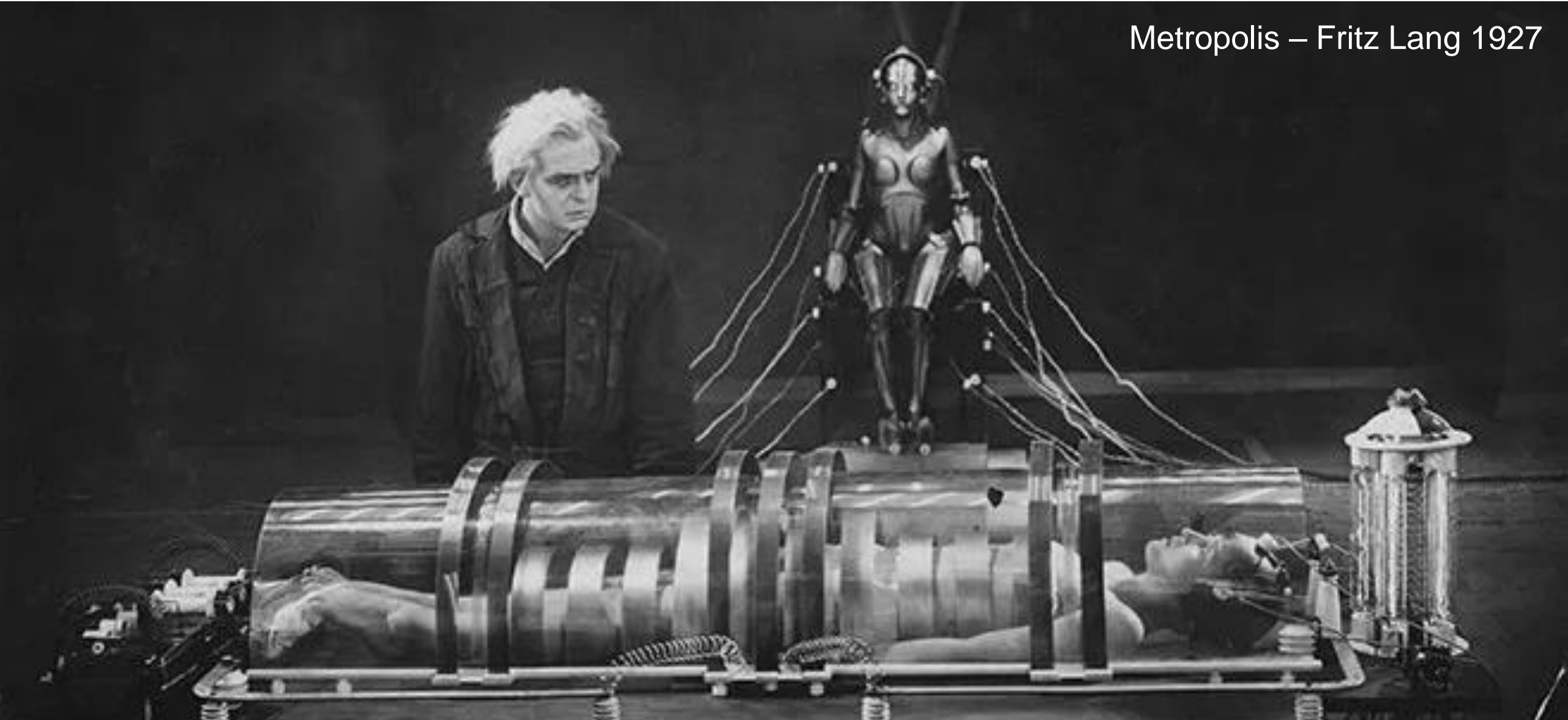
Florian Michahelles, Berkeley/CA

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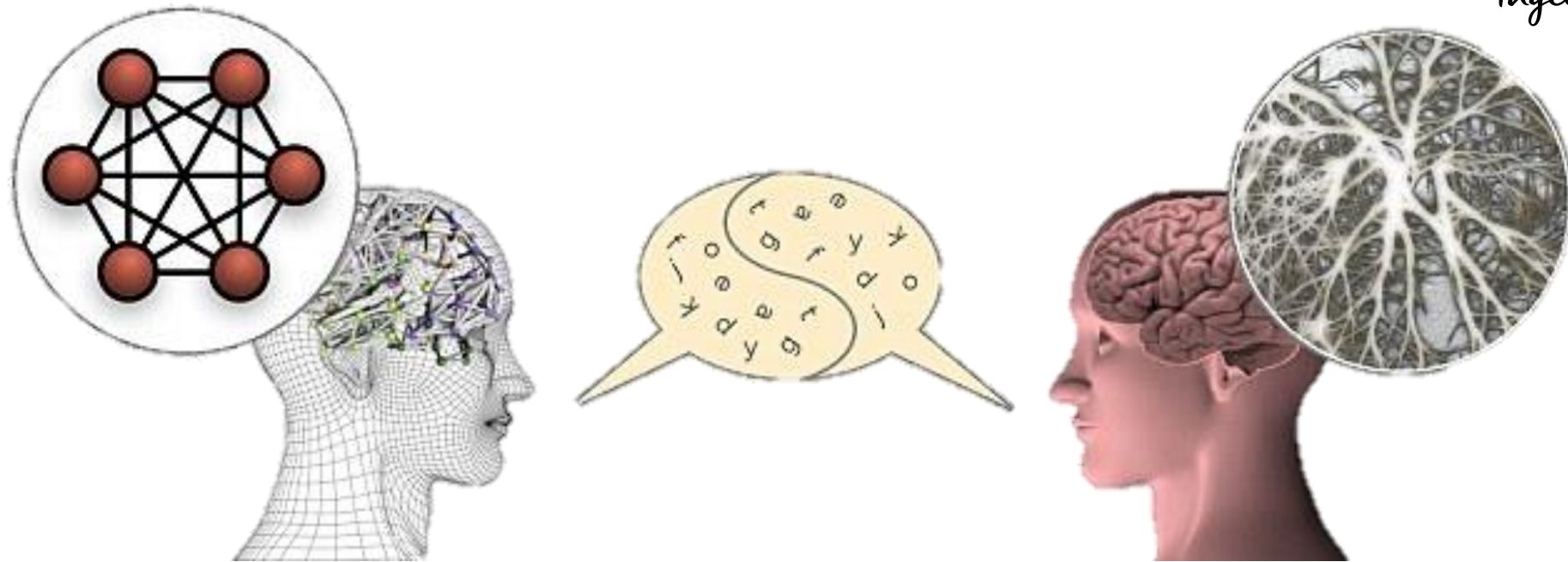*Ingenuity for life*

The popular fear

Metropolis – Fritz Lang 1927

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We create **digital companions** that **bridge between artificial intelligence** represented by Systems **and human intuition**.

This way we **relief human users from repetitive routines** (as systems take care of them) but free their minds to **focus on exceptional cases** that require **human intuition, creativity and world knowledge**.

We **construct user models** such that systems can **adapt to level of expertise** and emotional states: systems can become **empathic**. As a results, users become more satisfied, do less mistakes, and become more productive.

We establish seamless interaction between human and machine through intuitive, multi-modal and situation-aware interfaces, the so-called digital companions...

Digital Companion

- A digital companion aspires to help a user to better achieve her task.

- The digital companion remembers and interprets the user's behavior, adapts suggestions to goals and even anticipates the wishes of the user. Therefore, the companion has to become aware of the user's goals. The digital companion offers smart suggestions on how to proceed. The digital companion learns and improves over time. A natural dialogue between the user and the companion is realized by using adequate modalities, e.g. voice, gestures, etc..

Digital Companion

Knowledge Base	Adaptability	Embodiment

Characteristics
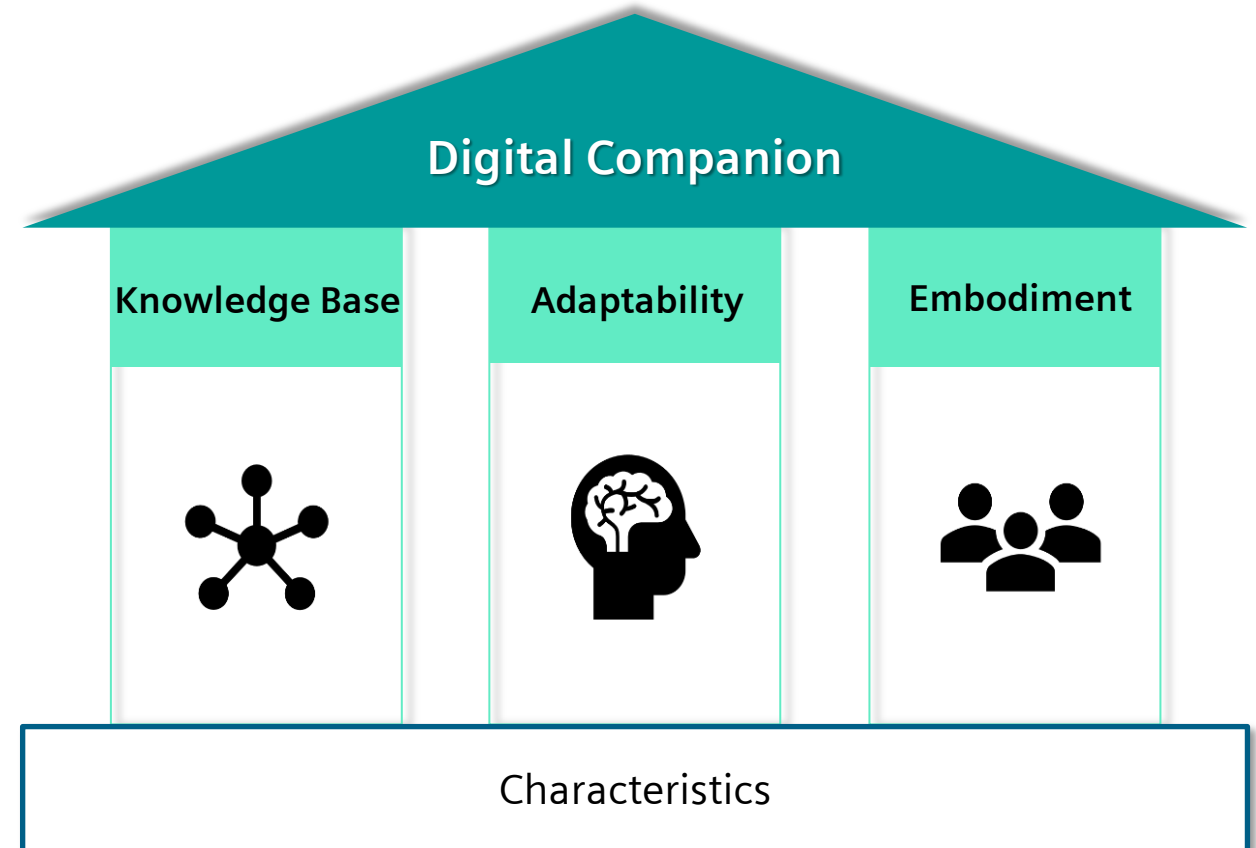
Augmenting the user vs replacing the user

- Pattern recognition/matching
- Recommender system
- Optimization
- Focus on descriptive feature
- Training data

- Creativity
- Intuition
- Non-routine, exception
- Critical thinking
- Big picture

→ Empower users to become more productive, faster and less prone to mistakes.

BableFishers:
Revolutionize your service engineering business
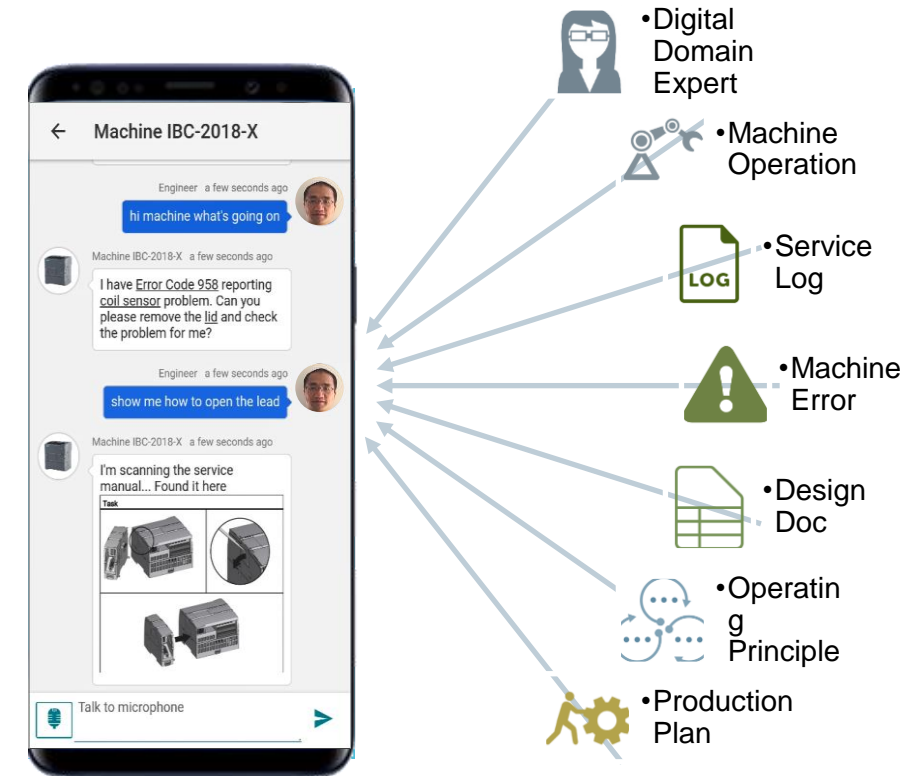
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Problem:

- **End customers** are facing
  - Downtime & loss of revenue
- **Service engineer** needs quick access to
  - Service information & repair instructions & product experts
- **Product experts** frequently interrupted with
  - Similar questions

Solution:

- Collect & process manuals, operation instructions, error codes
- Bring structured data in domain-specific Knowledge Graph

- ➤ Faster problem resolution & less factory downtime
- ➤ Instant access to expert knowledge & service records saves € 8 Mio. / y
- ➤ Less distractions & empowerment frees 100h / y

http://babelfishers.com

Contact: Dan.Yu@Siemens.com

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Gridstarter:
Managing the Smart Grid through Augmented Reality

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Problem:

- Smart grid operators use 2D dashboards to visualize and manage grid information: Amount of displayed information represents a high cognitive load
- Grid management applications do not provide an intuitive user interface that allow operators to have a global view of their managed grid clusters

Solution:

- AR application based on a semantic backend suggesting apps to solve a certain problem in an intuitive and immersive manner
- Allowing smart grid operators to adjust performance metric to computed app placements on their gird cluster

➢ Providing a visual alternative to grid operators, capable of reducing cognitive load of monitoring a dashboard and see raw numeric app placement results
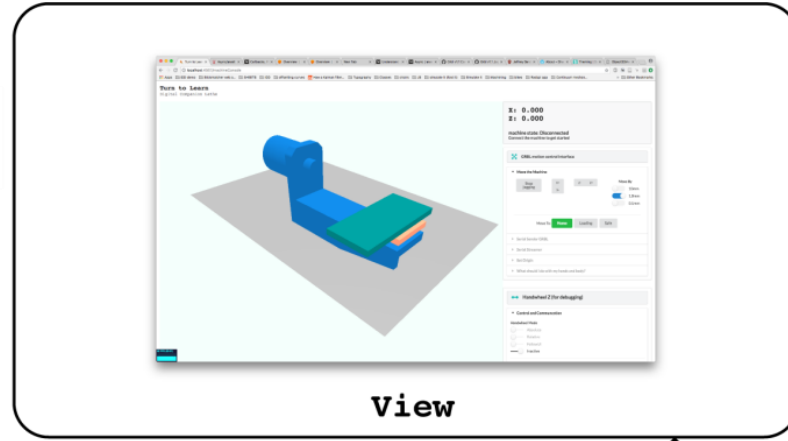
Contact: Kimberly.Garcia@Siemens.com

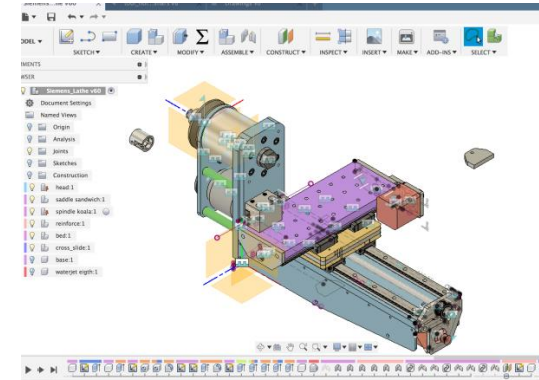# Work in progress: Lathe companion

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webGL visualiztions

three.js r95

SemanticUI CSS framework

S
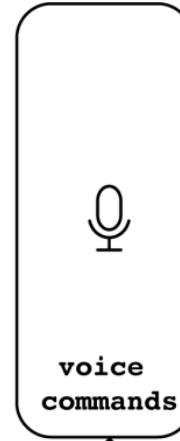
Sinatra Ruby web framework

Tornado Python web farmework

View

voice commands

dialogflow NLP

webhook

Web Application

websocket

Local Websocket Server

UART

HandWheel_1

HandWheel_2

Lathe motion controller
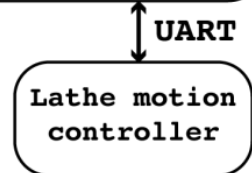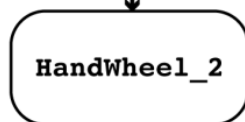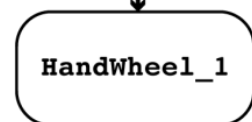
grbl

grbl CNC motion controller

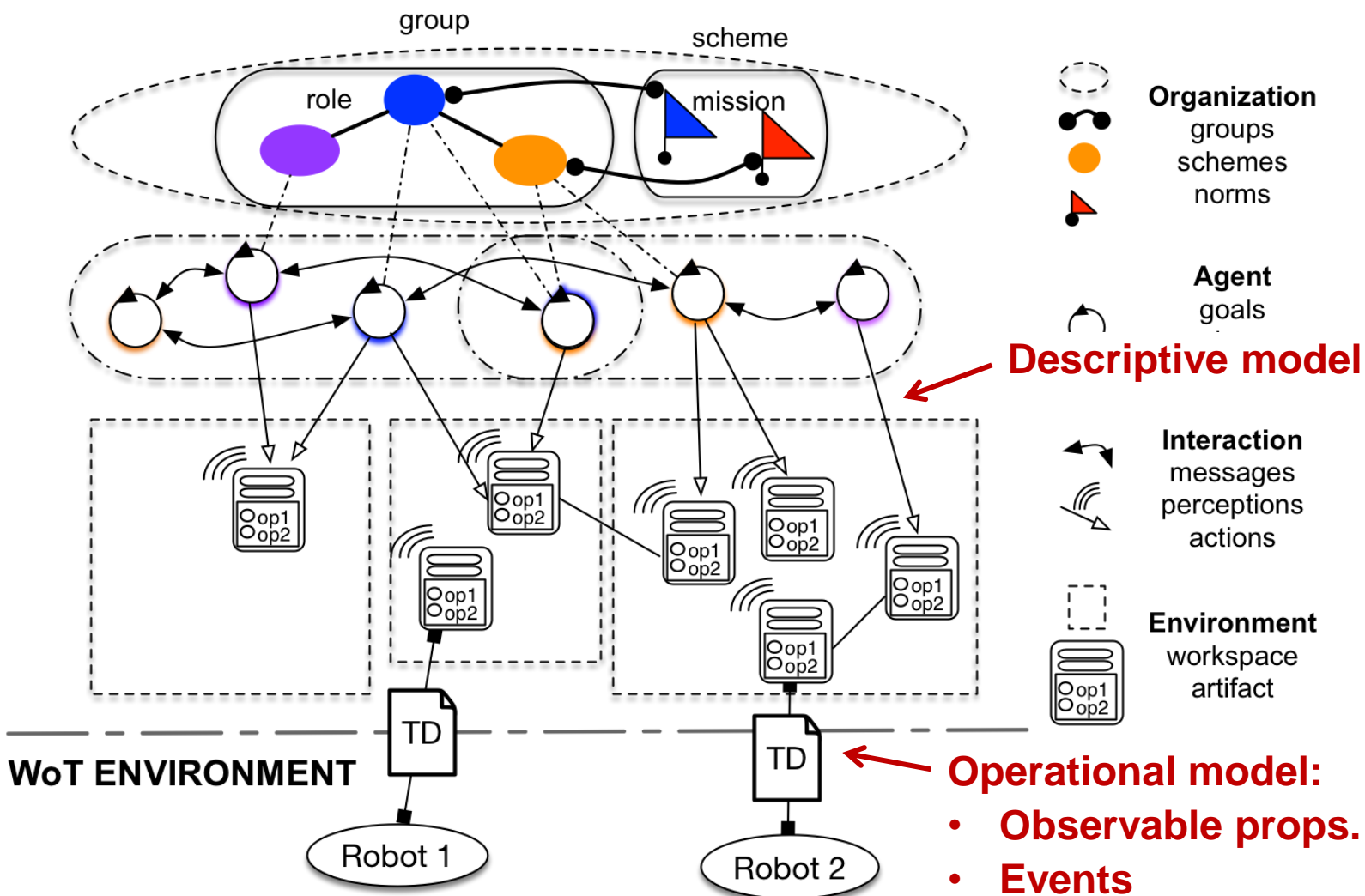Florian Michahelles / Siemens Corporate Technology

Autonomous Systems for Manufacturing

- On-the-fly repurposing of production lines

- Efficient mass customization of products

- Automatic component planning and procuring

- Bill of components

- etc.
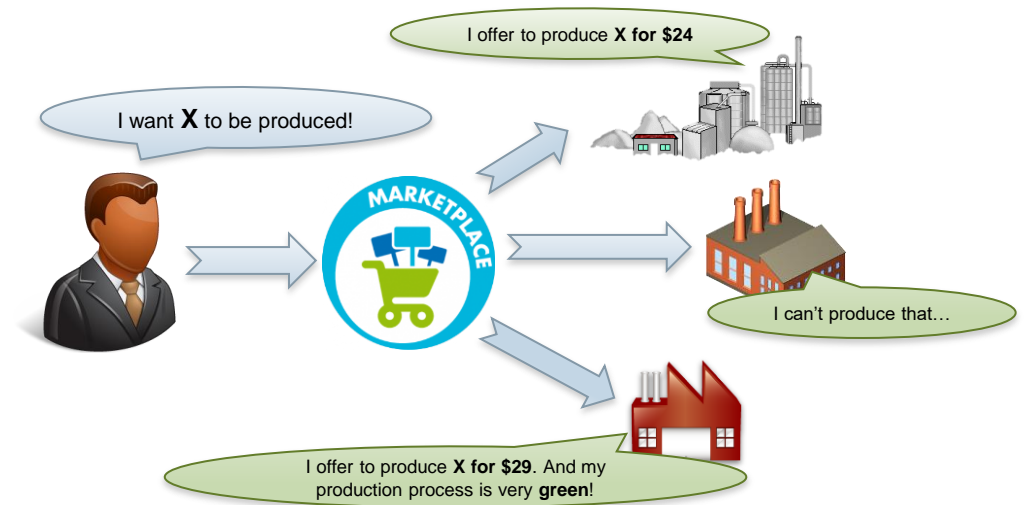
Move without object
```
{
    ?objectState a st:State ;
        log:includes {
            ex:PLCArmGripper ex:locatedIn ?gripperposition ;
                ex:grabbed "none".
        } .
    ?gripperposition a ex:PhysicalLocation3D .
    ?destination a ex:PhysicalLocation3D ;
        ex:hasX ?x ; ex:hasY ?y ; ex:hasZ ?z .
} => {
    _:request http:methodName "POST";
        http:requestURI
(<http://russet.ischool.berkeley.edu:8080/activities>);
        http:reqBody ("{ 'x': '"?x"', 'y': '"?y"', 'z': '"?z"'}").
    [ a st:StateChange ;
        st:replaced {
            ex:PLCArmGripper ex:locatedIn ?destination ;
                ex:grabbed "none".
        } ;
        st:parent ?objectState
    ] .
} .
```

Descriptive model + Operational model

Descriptive model

Operational model:
- **Observable props.**
- **Events**
- **Actions**

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Example: Manufacturing a stool with 4 padded legs

Mission:

Mount pads on legs
Attach legs to stool

Mission:
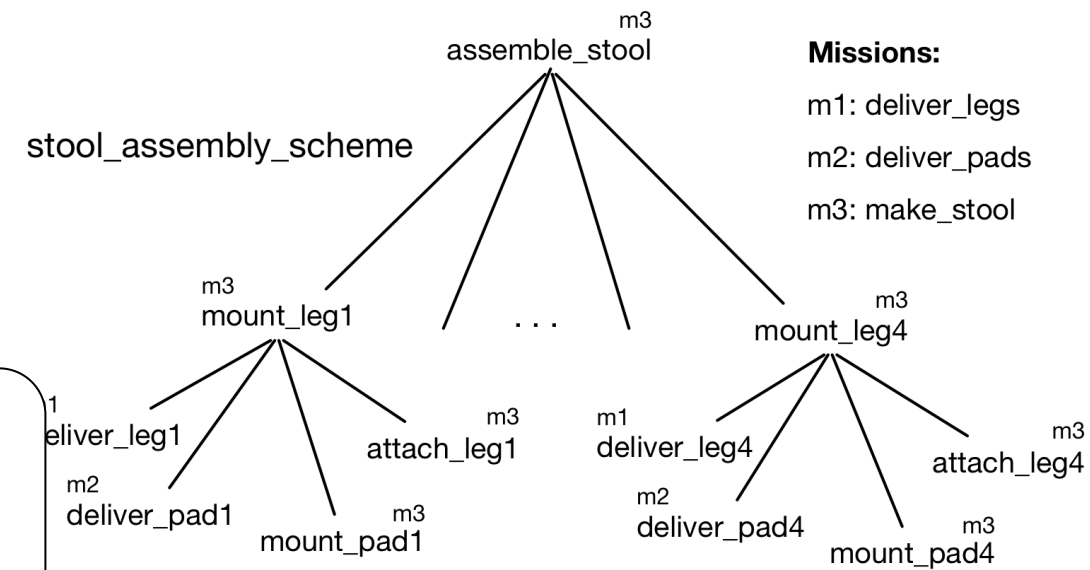Deliver legs

Mission:
Deliver pads

```
+!deliver_pad1 : true <-
    move(20, -3, 14)[artifact_name("plc_arm")];
    grab[artifact_name("plc_arm")];
    move(20, -3, 14)[artifact_name("plc_arm")];
    release[artifact_name("plc_arm")];
```
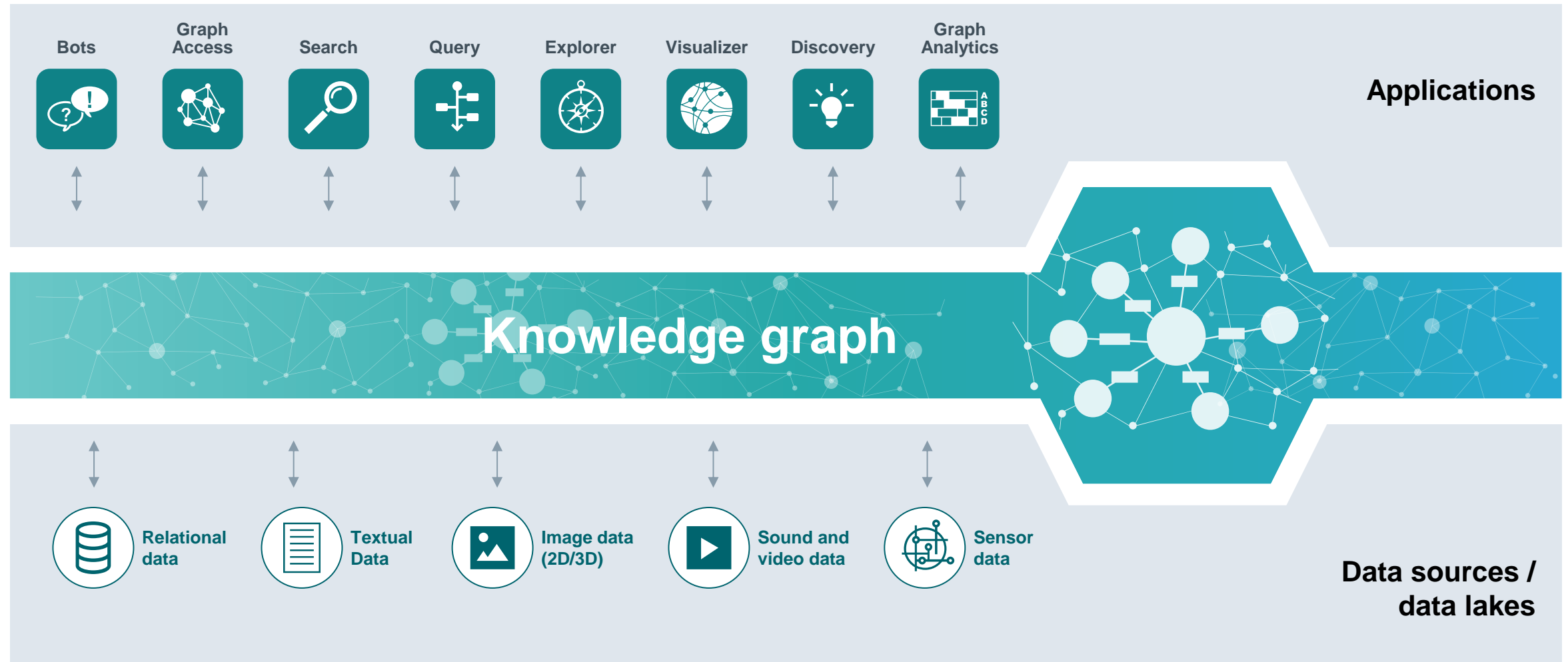
Organization specification:

- one group (with 3 roles): human_worker, leg_transporter, pad_transporter
- one manufacturing scheme:

m3
assemble_stool

stool_assembly_scheme

m3
mount_leg1

m3
mount_leg4

. . .

1
deliver_leg1

m3
attach_leg1

m1
deliver_leg4

m3
attach_leg4

m2
deliver_pad1

m3
mount_pad1

m2
deliver_pad4

m3
mount_pad4

Missions:

m1: deliver_legs

m2: deliver_pads

m3: make_stool

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Knowledge graph enables flexible linking of heterogeneous data via integrated & intuitive interfaces

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Applications

| Bots | Graph Access | Search | Query | Explorer | Visualizer | Discovery | Graph Analytics |

Knowledge graph

Data sources / data lakes

| Relational data | Textual Data | Image data (2D/3D) | Sound and video data | Sensor data |

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Knowledge graphs enable faster and better decision support for efficiency increase and new business opportunities

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Benefits of a Service Knowledge Engine within a service business

- Faster and better decision support

- Transparency about available data

- Immediate access to needed data

- Improved handling of heterogeneous and distributed data (e.g. 3D model data and time-series sensor data)

- Create insights despite imperfect data quality

- Graphs allow for incremental evolvement instead of "big bang"
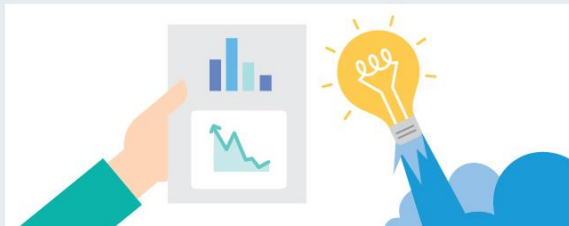
New (digital) service business models

- Premium services

- Customer self-service offers

- Knowledge-as-a-service

- Product & service bundles

- Performance based contracts

Example
Building Technologies

Improved building operations for real estate providers & end-users

Service growth and efficiency

- Service sales, e.g. higher opportunity hit rate

- Service delivery, e.g. higher first-time-fix

- Field experience mgmt.

Example
Power Services

Increased sales for modernization & upgrade services
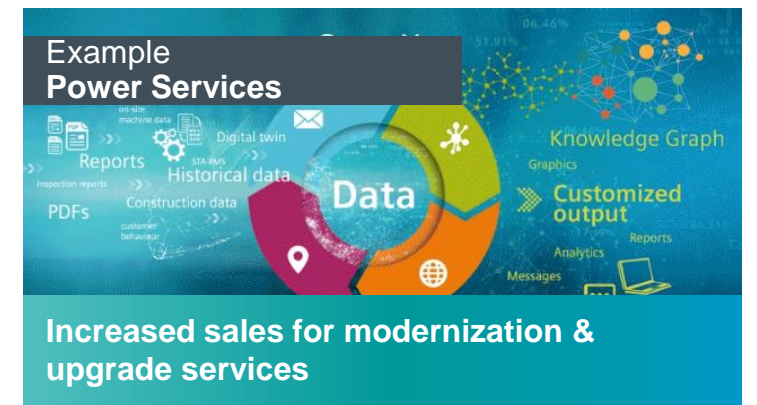
Knowledge graphs make it possible to query big amounts of data with high automation level

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How old is Joe Kaeser?

Google search without knowledge graph

Google search with knowledge graph

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How does it work? Google knowledge graph collects more than 100,000,000,000 facts from data in the internet
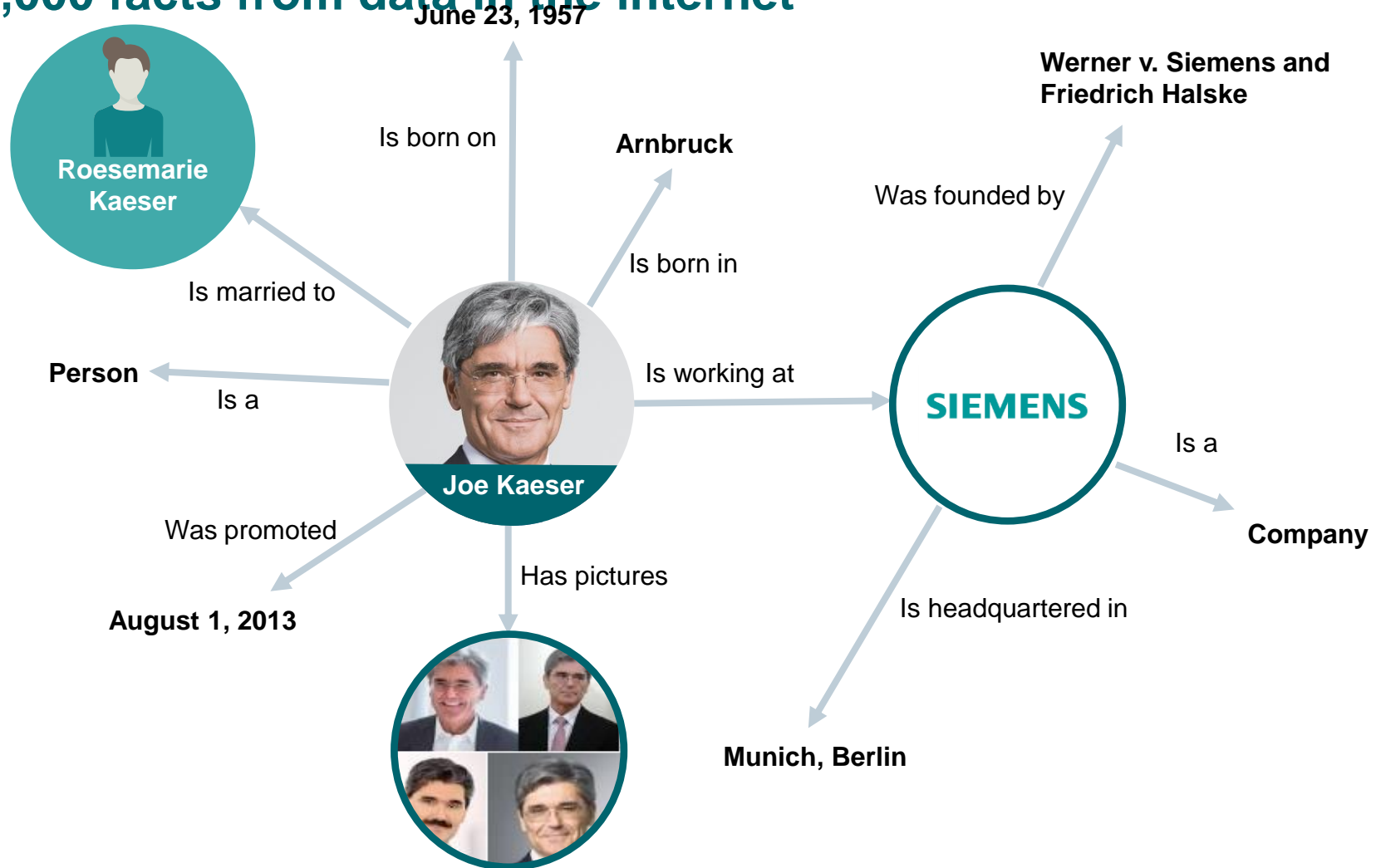
What are Graphs? Knowledge representation formalism semantic descriptions of entities and their relationships

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Objects
Real-world objects (things, places, people) and abstract concepts (genres, religions, professions)

Relationships
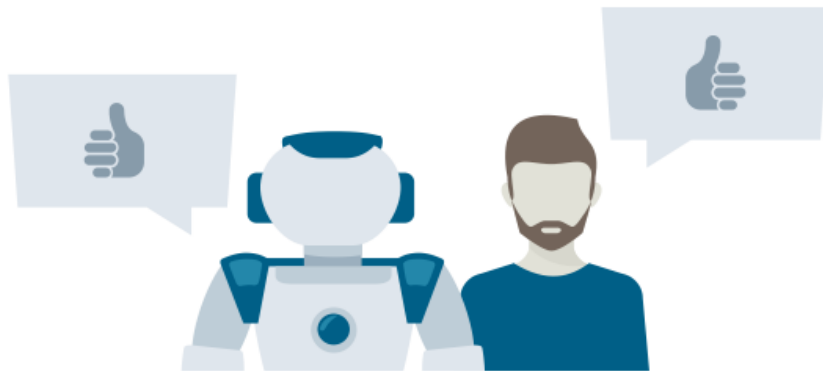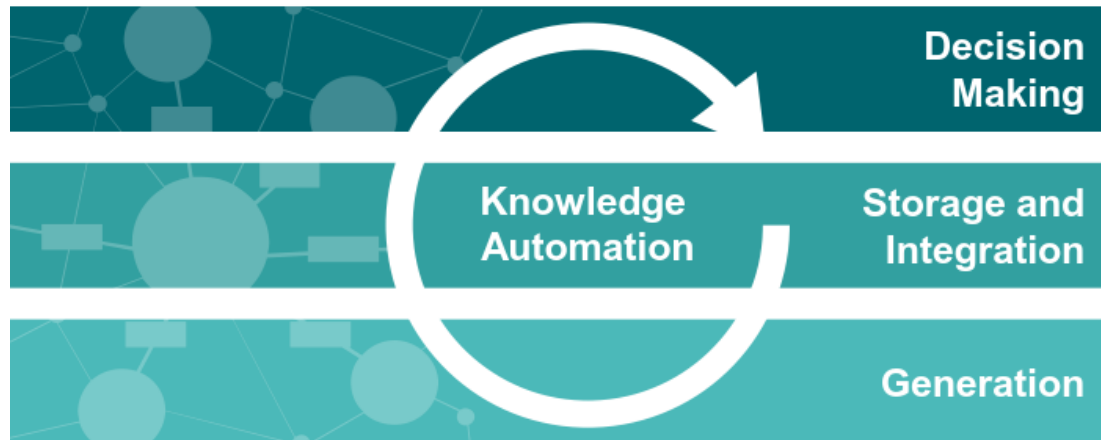Logical connection between two objects e.g. Joe Kaeser <u>is born in</u> Arnbruck

Semantic descriptions
The semantic description indicates the meaning of an object or relation, e.g. Joe Kaeser <u>is a person</u>
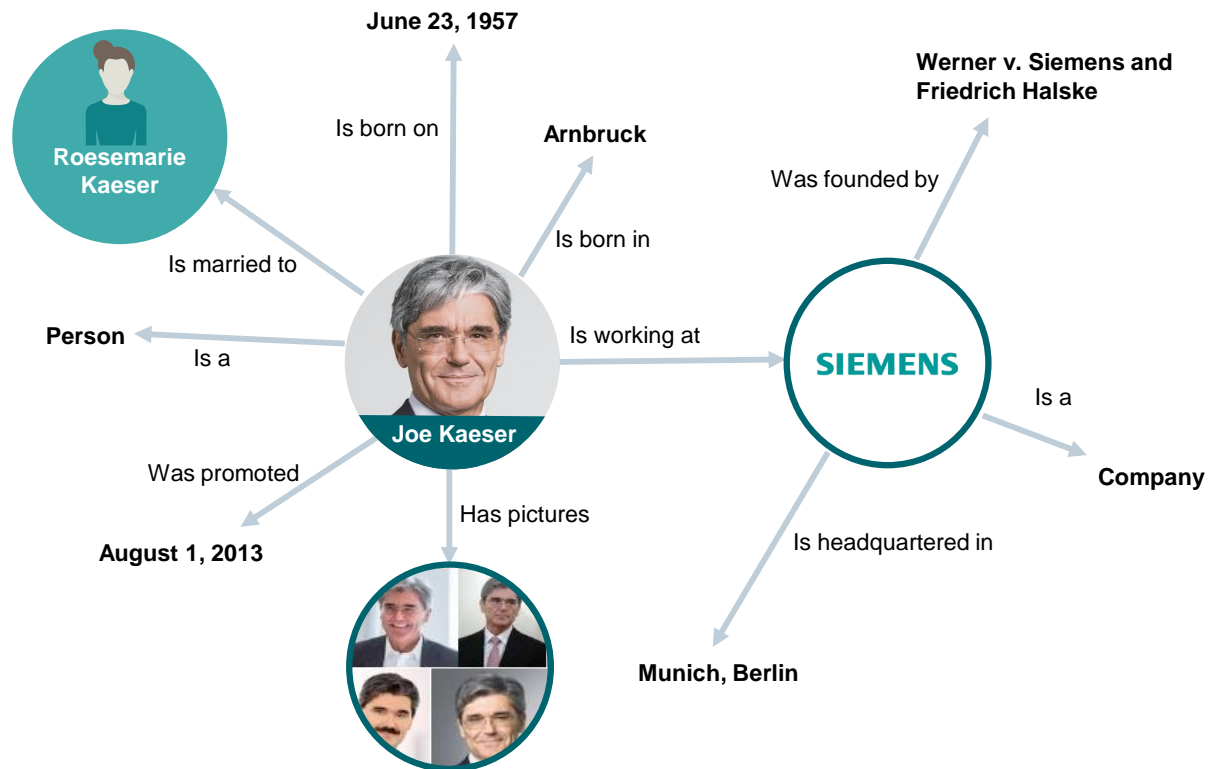
Rules make it possible to add further expert knowledge, e.g. "Siemens has to be a company, as a person is working there"

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Conclusions

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Knowledge Graph

Decision Making

Knowledge Automation

Storage and Integration

Generation

Machines   Humans

R&D Areas

Decision Making
- Explanation of AI decisions
- Data access: Semantic Search
- Knowledge Graph Decision Modeling

Storage and Integration
- Semantic Modelling and Knowledge Graphs
- Data integration and cleaning

Generation
- Extraction from unstructured data (inclusive text, audio, image)
- Automatic semantic annotation of structured data
- Learning of domain-specific rules/patterns

Relevant technologies

Decision Making
- Reasoning
- Machine/Deep Learning
- Question Answering

Storage and Integration
- Graph/NoSQL databases
- Constraints and Rules
- Probabilistic programming
- Ontologies

Generation
- NLP/Text understanding
- Machine/Deep Learning
- Computer vision
- Sound recognition
- Virtual data Integration/OBDA
- Information retrieval
- …

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What's left for the human?

➢ A series of non-routine tasks that requires social intelligence, complex critical thinking and creative problem solving.

Thank you very much!

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